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Computational Fluid Dynamic Solutions Formulas

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List of 11 Computational Fluid Dynamic Solutions Formulas

Computational Fluid Dynamic Solutions

1) Emissivity

Open Calculator

fx $$\varepsilon = \sqrt{\frac{\mu_{viscosity}}{\rho_{\infty} \cdot V_{\infty} \cdot r_{nose}}}$$

ex $$0.930447 = \sqrt{\frac{375\text{P}}{1.225\text{kg/m}^3 \cdot 68\text{m/s} \cdot 0.52\text{m}}}$$

2) Emissivity given Reference Temperature

Open Calculator

fx $$\varepsilon = \sqrt{\frac{\mu_{viscosity}}{\rho_{\infty} \cdot \sqrt{T_{ref}} \cdot r_{nose}}}$$

ex $$0.929043 = \sqrt{\frac{375\text{P}}{1.225\text{kg/m}^3 \cdot \sqrt{4652\text{K}} \cdot 0.52\text{m}}}$$

3) Freestream Density

Open Calculator

fx $$\rho_{\infty} = \frac{\mu_{viscosity}}{\varepsilon^2 \cdot V_{\infty} \cdot r_{nose}}$$

ex $$1.175092\text{kg/m}^3 = \frac{375\text{P}}{(0.95)^2 \cdot 68\text{m/s} \cdot 0.52\text{m}}$$

4) Freestream Density given Reference Temperature

Open Calculator

fx $$\rho_{\infty} = \frac{\mu_{viscosity}}{\varepsilon^2 \cdot \sqrt{T_{ref}} \cdot r_{nose}}$$

ex $$1.17155\text{kg/m}^3 = \frac{375\text{P}}{(0.95)^2 \cdot \sqrt{4652\text{K}} \cdot 0.52\text{m}}$$

5) Freestream Velocity

Open Calculator

fx $$V_{\infty} = \frac{\mu_{viscosity}}{\varepsilon^2 \cdot \rho_{\infty} \cdot r_{nose}}$$

ex $$65.22959\text{m/s} = \frac{375\text{P}}{(0.95)^2 \cdot 1.225\text{kg/m}^3 \cdot 0.52\text{m}}$$

6) Nose Radius of Coordinate System

Open Calculator

$$r_{nose} = \frac{\mu_{viscosity}}{\varepsilon^2 \cdot \rho_\infty \cdot V_\infty}$$

$$0.498814\text{m} = \frac{375\text{P}}{(0.95)^2 \cdot 1.225\text{kg/m}^3 \cdot 68\text{m/s}}$$

7) Nose Radius of Coordinate System given Reference Temperature

Open Calculator

$$r_{nose} = \frac{\mu_{viscosity}}{\varepsilon^2 \cdot \rho_\infty \cdot \sqrt{T_{ref}}}$$

$$0.497311\text{m} = \frac{375\text{P}}{(0.95)^2 \cdot 1.225\text{kg/m}^3 \cdot \sqrt{4652\text{K}}}$$

8) Reference Temperature given Emissivity

Open Calculator

$$T_{ref} = \sqrt{\frac{\mu_{viscosity}}{\varepsilon^2 \cdot \rho_\infty \cdot r_{nose}}}$$

$$8.076484\text{K} = \sqrt{\frac{375\text{P}}{(0.95)^2 \cdot 1.225\text{kg/m}^3 \cdot 0.52\text{m}}}$$

9) Reference Temperature given Freestream Velocity

Open Calculator

$$T_{ref} = V_\infty^2$$

$$4624\text{K} = (68\text{m/s})^2$$

10) Reference Viscosity

Open Calculator

fx $\mu_{viscosity} = \varepsilon^2 \cdot \rho_\infty \cdot V_\infty \cdot r_{nose}$

ex $390.9269\text{P} = (0.95)^2 \cdot 1.225\text{kg/m}^3 \cdot 68\text{m/s} \cdot 0.52\text{m}$

11) Reference Viscosity Given Reference Temperature

Open Calculator

fx $\mu_{viscosity} = \varepsilon^2 \cdot \rho_\infty \cdot \sqrt{T_{ref}} \cdot r_{nose}$

ex $392.1087\text{P} = (0.95)^2 \cdot 1.225\text{kg/m}^3 \cdot \sqrt{4652\text{K}} \cdot 0.52\text{m}$

Variables Used

- r_{nose} Radius of Nose *(Meter)*
- T_{ref} Reference Temperature *(Kelvin)*
- V_{∞} Freestream Velocity *(Meter per Second)*
- ε Emissivity
- $\mu_{viscosity}$ Dynamic Viscosity *(Poise)*
- ρ_{∞} Freestream Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Dynamic Viscosity** in Poise (P)
  Dynamic Viscosity Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion

Check other formula lists

- Approximate Methods of Hypersonic Inviscid Flowfields Formulas
- Basic Aspects, Boundary Layer Results, and Aerodynamic Heating of Viscous Flow Formulas
- Blast Wave Part Theory Formulas
- Boundary Layer Equations for Hypersonic Flow Formulas
- Computational Fluid Dynamic Solutions Formulas
- Elements of Kinetic Theory Formulas
- Exact Methods of Hypersonic Inviscid Flowfields Formulas
- Hypersonic Equivalence Principle and Blast-Wave Theory Formulas
- Hypersonic Flight Paths Velocity of Altitude Map Formulas
- Hypersonic Small Disturbance Equations Formulas
- Hypersonic Viscous Interactions Formulas
- Laminar Boundary Layer at Stagnation point on Blunt body Formulas
- Newtonian Flow Formulas
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